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Original Article

MECHANICAL PROPERTIES OF GLASS/BAMBOO FIBERS REINFORCED EPOXY COMPOSITES COMPARING WITH CHOPPED STRAND MAT TREATED WITH BACTERIAL CELLULOSE

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ABSTRACT

Fiber-reinforced epoxy composites have played a principal role for a lengthy time of applications for their strength, cost-effectiveness, lightweight, and degradability. An innovative method of manufacturing rigid and robust natural fiber preforms is studied. In this connection, an investigation has been carried out to make use of Glass/Bamboo Chopped strand mat treated with bacterial cellulose. The preamble of bacterial cellulose improves the strength and stiffness of the preform. With this preform, the hierarchical composites are manufactured by using conventional composite production methods, such as resin film infusion RFI or resin transfer molding RTM. The present work describes the development and characterization of mechanical properties of Glass/Bamboo Chopped strand mat fiber-based composites consisting of reinforcement and epoxy as a matrix. Tensile, Compressive, Flexural and Impact properties are determined using Universal Testing Machine UTM.

***KEYWORDS*: Glass Fiber, Bamboo Fiber, Chopped Strand Mat Fiber, Bacterial Cellulose & Vacuum Bag**

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INTRODUCTION

Many studies on the composites made from polyester, epoxy matrix and natural fibers like wood, banana, sisal, coir, cardia dicotama, wheat straw were reported in the literature [1-3]. Wong *et al* [4] studied the bamboo fiber reinforced polyester composites on its tensile properties and concluded that the strength increases as the fiber content increases. Varadharajulu *et al* [5] reported on the chemical resistance of epoxy, polyester natural fibers have good strength when these are alkali treated. Osorio *et al* [6] investigated on the morphological studies of both treated and untreated natural fiber hybrid composites and concluded that mechanical properties of the composite samples are more for the treated samples when compared to untreated samples. Oushabi *et al* [7] investigated the thermal, mechanical, morphological and chemical properties of palm date fibers. Chawla and A.C. Bastor [8] investigated on jute fiber reinforced polyester composites.

MATERIALS AND METHODS

Preparation of Bacterial Cellulose-Sisal Fiber Suspension

Wet mass bacterial cellulose is dried in vacuum at 80^{o}C for overnight. Measure 18gms of dry bacterial cellulose and cut these pellicles using scissors. Soak these pellicles in water for hydration. Feed these into a blender by adding some water for 2min. Pour this into the15L container by adding 14L of water. Stir the suspension to fix the fibers uniformly.

Preparation of Composite Specimen

In the present work, glass molds are used to prepare the reinforced epoxy composites. Glass mold of size 200x200x3mm is used to prepare sheets are specimens for tensile, flexural and impact tests. Another glass mold of 200x200x10mm is used to prepare sheets and specimens for compressive tests.

RESULTS AND DISCUSSIONS

Tensile Load Measurement

The tensile stress and Young's modulus was determined using INSTRON-3369 model UTM. The crosshead speed for the tensile test was maintained at 10mm/min. The test is conducted as per ASTM D 3039-76 specifications. The temperature and humidity of this test were maintained at 18˚C and 25% respectively. In each case, 3 samples were tested and average values were calculated.

Table 1 Results of the tensile properties of glass/bamboo fibers reinforced epoxy composites for untreated, treated conditions and chopped strand mat treated with bacterial cellulose

Table 1

Glass/Bamboo Untreated (MPa)	Glass/Bamboo Treated (MPa)	Chopped Strand Mat Treated with Bacterial Cellulose (MPa)
153	197	210

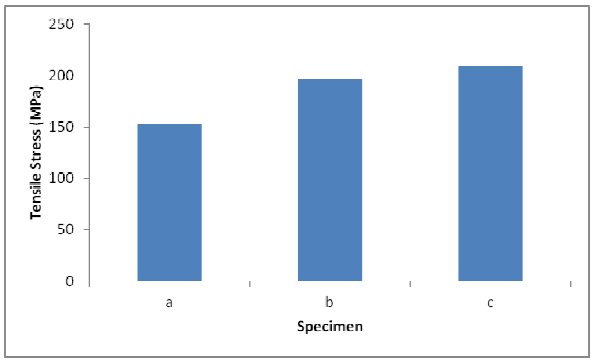

Figure 1: Variation of Tensile Stress
(a) Untreated Bamboo Glass Fiber,
(b) Treated Bamboo/Glass Fiber and
(c) Chopped Strand Mat Treated with Bacterial Cellulose

Table 2 Results of the Young's modulus of glass/bamboo fibers reinforced epoxy composites for untreated, treated conditions and chopped strand mat treated with bacterial cellulose

Table 2

Glass/Bamboo Untreated (MPa)	Glass/Bamboo treated (MPa)	Chopped Strand Mat treated with Bacterial Cellulose (MPa)
7894	9167	9984

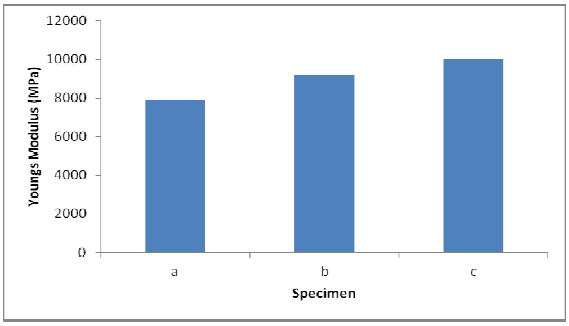

Figure 2: Variation of Young's Modulus (a) Untreated Bamboo Glass Fiber, (b) Treated Bamboo/Glass Fiber and (c) Chopped Strand Mat Treated with Bacterial Cellulose

Compression Stress Measurement

The compression stress and Young's modulus was determined using INSTRON-3369 model UTM. The crosshead speed for compression test was maintained at 5mm/min. The test is conducted as per ASTM D 3410/695 specifications. The temperature and humidity of this test were maintained at 18˚C and 50% respectively. In each case, 3 samples were tested and average values were calculated.

Table 3 shows the results of the compressive properties a) untreated bamboo glass fiber, b) treated bamboo/glass fiber and c) Chopped Strand Mat treated with Bacterial Cellulose

Table 3

Glass/Bamboo Untreated (MPa)	Glass/Bamboo Treated (MPa)	Chopped Strand Mat Treated with Bacterial Cellulose (MPa)
128	218	300

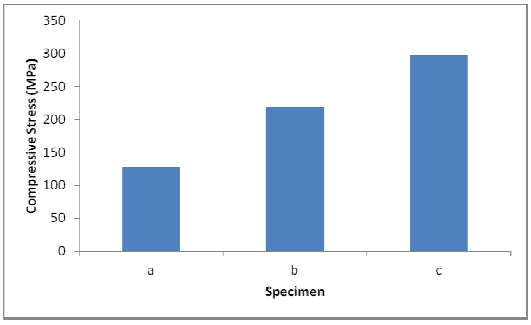

Figure 3: Variation of Compressive Stress with (a) Untreated Bamboo Glass Fiber, (b) Treated Bamboo/Glass Fiber and (c) Chopped Strand Mat Treated with Bacterial Cellulose

Table 4 shows the results of the young's modulus with a) untreated bamboo glass fiber, b) treated bamboo/glass fiber and c) Chopped Strand Mat treated with Bacterial Cellulose

Table 4

t	Glass/Bamboo Treated (MPa)	Chopped Strand Mat Treated with Bacterial Cellulose (MPa)
3060	3127	4169

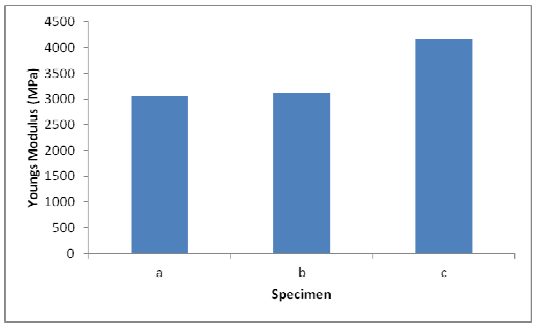

Figure 4: Variation of Young's Modulus with (a) Untreated Bamboo Glass Fiber, (b) Treated Bamboo/Glass Fiber and (c) Chopped Strand Mat Treated with Bacterial Cellulose

Flexural Stress Measurement

The flexural stress and flexural modulus were determined using INSTRON-3369 model UTM. The crosshead speed for compression test was maintained at 5mm/min. The test is conducted as per ASTM D 5943-96 specifications. The temperature and humidity of this test were maintained at 18˚C and 50% respectively. In each case, 3 samples were tested and average values were calculated.

Table 5 shows the results of the flexural properties with a) untreated bamboo glass fiber, b) treated bamboo/glass fiber and c) Chopped Strand Mat treated with Bacterial Cellulose

Table 5

Glass/Bamboo Untreated (MPa)	Glass/Bamboo Treated (MPa)	Chopped Strand Mat Treated with Bacterial Cellulose (MPa)
139	168	260

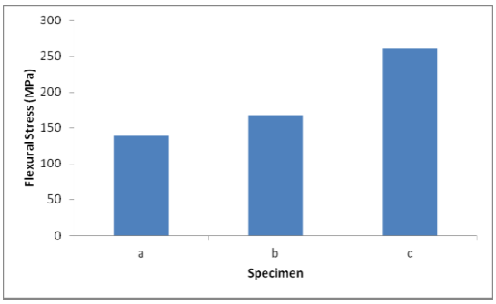

Figure 5: Variation of Flexural Stress with (a) Untreated Bamboo Glass Fiber, (b) Treated Bamboo/Glass Fiber and (c) Chopped Strand Mat Treated with Bacterial Cellulose

Table 6 shows the results of the Young's modulus with a) untreated bamboo glass fiber, b) treated bamboo/glass fiber and c) Chopped Strand Mat treated with Bacterial Cellulose

Table 6

Glass/Bamboo Untreated (MPa)	Glass/Bamboo Treated (MPa)	Chopped Strand Mat Treated with Bacterial Cellulose (MPa)
8183	9205	12886

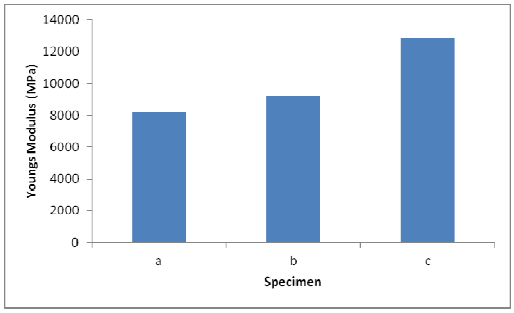

Figure 6: Variation of Young's Modulus with (a) Untreated Bamboo Glass Fiber, (b) Treated Bamboo/Glass Fiber and (c) Chopped Strand Mat Treated with Bacterial Cellulose

Impact Strength Measurement

The impact strength is determined using IZOD impact tester. The samples were made as per ASTM 256-88 specifications. In each case, 3 samples were tested and average values were calculated.

Table 7 shows the results of the impact properties of glass/bamboo fibers reinforced epoxy composites for untreated, treated conditions and chopped strand mat treated with bacterial cellulose with types of treatments

Table 7

Glass/Bamboo Untreated (J/m)	Glass/Bamboo Treated (MPa)	Chopped Strand Mat treated with Bacterial Cellulose (MPa)
338	350	425

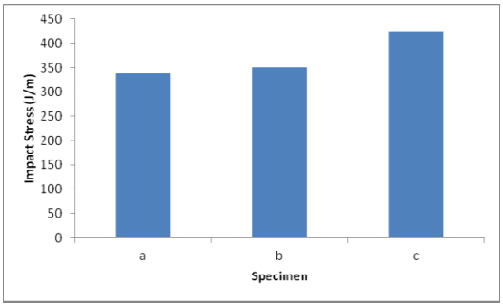

Figure 7: Variation of Impact Stress with (a) Untreated Bamboo Glass Fiber, (b) Treated Bamboo/Glass Fiber and (c) Chopped Strand Mat Treated with Bacterial Cellulose

CONCLUSIONS

The present investigated the mechanical behavior of bamboo/ glass fibers reinforced epoxy composites for untreated, treated conditions and chopped strand mat treated with bacterial cellulose. When compared to Glass/Bamboo, Chopped strand mat treated with Bacterial Cellulose mechanical properties increases.

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